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Claims

[c1] A process for making a lignocellulose-based anion-adsorbing medium (LAM) with a positive charge, comprising the steps of:

a. dissociating cations from their counterions by adding a chemical compound containing said cations to water and acidifying;

b. pelletizing a lignocellulose having hydroxyl groups (−OH);

c. adsorbing the cations to the pelletized lignocellulose by bringing the lignocellulose into contact with the solution of step (a) and incubating; and,

d. incubating the lignocellulose of step (c) with an alkaline fixing agent that catalyzes the exchange of hydrogens (H) of the hydroxyl groups of the lignocellulose with the cations to produce the LAM with a positive charge.

[c2] A composition made by the process of Claim 1.

[c3] The process of Claim 1, wherein the cations are selected from the group consisting of Fe, Al, Ca, Mg, Mn, Co, Mo, Ni and Zn.

[c4] The process of Claim 1, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.

[c5] The process of Claim 1, further comprising drying the lignocellulose after adsorbing the cations.

[c6] The process of claim 1, wherein incubating occurs under vacuum.

[c7] The process of claim 1, wherein incubating occurs at step (c) under vacuum.

[c8] The process of claim 1, wherein incubating occurs at step (d) under vacuum.

[c9] The process of claim 1, wherein incubating occurs at step (d) under pressure.

[c10] A process for making a lignocellulose-based anion-adsorbing medium (LAM) with a positive charge, comprising the steps of:

a. dissociating Fe cations from their counterions by adding a chemical compound containing said cations to water and acidifying;

b. pelletizing a lignocellulose having hydroxyl groups (−OH);

c. adsorbing the Fe cations to the pelletized lignocel-

lulose by bringing the lignocellulose into contact with the solution of step (a) and incubating; and,

d. incubating the lignocellulose of step (c) with an alkaline fixing agent that catalyzes the exchange of hydrogens (H) of the hydroxyl groups of the lignocellulose with the Fe cations to produce the LAM with a positive charge.

[c11] A composition made by the process of Claim 10.

[c12] The process of Claim 10, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.

[c13] The process of Claim 10, further comprising drying the lignocellulose after adsorbing the cations.

[c14] The process of claim 10, wherein incubating occurs under vacuum.

[c15] The process of claim 10, wherein incubating occurs at step (c) under vacuum.

[c16] The process of claim 10, wherein incubating occurs at step (d) under vacuum.

[c17] The process of claim 10, wherein incubating occurs at step (d) under pressure

[c18] A process for making a lignocellulose-based anion-adsorbing medium (LAM) with a positive charge, comprising the steps of:

a. dissociating Al cations from their counterions by adding a chemical compound containing said cations to water and acidifying;

b. pelletizing a lignocellulose having hydroxyl groups (−OH);

c. adsorbing the Al cations to the pelletized lignocellulose by bringing the lignocellulose into contact with the solution of step (a) and incubating; and,

d. incubating the lignocellulose of step (c) with an alkaline fixing agent that catalyzes the exchange of hydrogens (H) of the hydroxyl groups of the lignocellulose with the Al cations to produce the LAM with a positive charge.

[c19] A composition made by the process of Claim 18.

[c20] The process of Claim 18, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.

[c21] The process of Claim 18, further comprising drying the lignocellulose after adsorbing the cations.

[c22] The process of claim 18, wherein incubating occurs un-

der vacuum.

[c23] The process of claim 18, wherein incubating occurs at step (c) under vacuum.

[c24] The process of claim 18, wherein incubating occurs at step (d) under vacuum.

[c25] A composition made by:

a. dissociating cations selected from the group consisting of Fe, Al and Ca, from their counterions by adding a chemical compound containing said cations to water and acidifying;

b. pelletizing a lignocellulose having hydroxyl groups (−OH);

c. adsorbing the cations to the pelletized lignocellulose by bringing the lignocellulose into contact with the solution of step (a) and incubating; and,

d. incubating the lignocellulose of step (c) with an alkaline fixing agent that catalyzes the exchange of hydrogens (H) of the hydroxyl groups of the lignocellulose with the cations to produce the composition.

[c26] A process for treating a contaminated aqueous solution to remove one or more anionic contaminants therefrom, comprising:

a. contacting the contaminated aqueous solution

with a lignocellulose-based anion-adsorbing medium (LAM), wherein the LAM has been formed by the steps of:

i. dissociating cations selected from the group consisting of Fe and Al, from their counterions by adding a chemical compound containing said cations to water and acidifying;

ii. pelletizing a lignocellulose having hydroxyl groups (−OH);

iii. adsorbing the cations to a lignocellulose having hydroxyl groups (−OH) by bringing the lignocellulose into contact with the solution of step (i) and incubating; and,

iv. replacing hydrogens (H) of the hydroxyl groups of the lignocellulose with the cations to produce the LAM with a positive charge by exposing the lignocellulose of step (iii) to an alkaline fixing agent; and,

b. recovering a treated aqueous solution with reduced content of the one or more anionic contaminants.

[c27] The method of Claim 26, wherein the one or more anionic contaminants is selected from the group consisting

of phosphate and arsenic.

[c28] The method of Claim 26, further comprising regenerating the LAM after its contact with the contaminated aqueous solution by treating the LAM with an alkaline solution to remove the one or more anionic contaminants from the LAM to which said one or more anionic contaminants have been adsorbed, and subsequently neutralizing the LAM with an acid to prepare it for reuse.

[c29] The method of Claim 26, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.

[c30] A process for treating a contaminated aqueous solution to remove one or more phosphate anionic contaminants therefrom, comprising:

a. contacting the contaminated aqueous solution with a lignocellulose-based anion-adsorbing medium (LAM), wherein the LAM has been formed by the steps of:

i. dissociating cations selected from the group consisting of Fe, Al and Ca, from their counterions by adding a chemical compound containing said cations to water and acidifying;

ii. pelletizing a lignocellulose having hydroxyl

groups (−OH);

iii. adsorbing the cations to a lignocellulose having hydroxyl groups (−OH) by bringing the lignocellulose into contact with the solution of step (i) and incubating; and,

iv. replacing hydrogens (H) of the hydroxyl groups of the lignocellulose with the cations to produce the LAM with a positive charge by exposing the lignocellulose of step (iii) to an alkaline fixing agent; and,

b. recovering a treated aqueous solution with reduced content of the phosphate anionic contaminants.

[c31] The method of Claim 30, further comprising regenerating the LAM after its contact with the contaminated aqueous solution by treating the LAM with an alkaline solution to remove the phosphate anionic contaminants from the LAM to which the phosphate anionic contaminants have been adsorbed, and subsequently neutralizing the LAM with an acid to prepare it for reuse.

[c32] The method of Claim 30, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.

[c33] A process for treating a contaminated aqueous solution to remove one or more arsenic anionic contaminants therefrom, comprising:

a. contacting the contaminated aqueous solution with a lignocellulose-based anion-adsorbing medium (LAM), wherein the LAM has been formed by the steps of:

i. dissociating cations selected from the group consisting of Fe, Al and Ca, from their counterions by adding a chemical compound containing said cations to water and acidifying;

ii. pelletizing a lignocellulose having hydroxyl groups (−OH);

iii. adsorbing the cations to a lignocellulose having hydroxyl groups (−OH) by bringing the lignocellulose into contact with the solution of step (i) and incubating; and,

iv. replacing hydrogens (H) of the hydroxyl groups of the lignocellulose with the cations to produce the LAM with a positive charge by exposing the lignocellulose of step (iii) to an alkaline fixing agent; and,

b. recovering a treated aqueous solution with reduced content of the arsenic anionic contaminants.

[c34] The method of Claim 33, further comprising regenerating the LAM after its contact with the contaminated aqueous solution by treating the LAM with an alkaline solution to remove the arsenic anionic contaminants from the LAM to which the arsenic anionic contaminants have been adsorbed, and subsequently neutralizing the LAM with an acid to prepare it for reuse.

[c35] The method of Claim 33, wherein the lignocellulose is selected from the group consisting of wood, paper, and cotton.